(19)日本国特許庁（ＪＰ）　(12)特　許　公　報（Ｂ２）　(11)特許番号

第2543269号

(45)発行日　平成８年(1996)10月16日　(24)登録日　平成８年(1996)７月25日

(51)Int.Cl.[6]		識別記号	庁内整理番号	ＦＩ		技術表示箇所
Ｂ２３Ｋ	9/073	５３５	8315−4E	Ｂ２３Ｋ	9/073	５３５
// Ｂ２３Ｋ	9/23		8315−4E		9/23	Ｆ

請求項の数１(全　３　頁)

(21)出願番号　特願平3−128995

(22)出願日　平成３年(1991)５月31日

(65)公開番号　特開平4−356364

(43)公開日　平成４年(1992)12月10日

(73)特許権者　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地

(72)発明者　萩原　清吾
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　大山　英俊
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　北島　明彦
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(74)代理人　弁理士　滝本　智之

審査官　加藤　友也

(56)参考文献　特開　昭53−119758（ＪＰ，Ａ）

(54)【発明の名称】　アーク溶接法

(57)【特許請求の範囲】

【請求項１】　電源から供給する電流に交流電流期間と直流電流期間とを周期的に繰り返す溶接電流を用い、その周波数を０．５～１０［Hz］とし、かつ前記交流電流期間の比率を３０～８０［％］としたことを特徴とするアーク溶接法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、ＦＡに適した高性能アーク溶接法に関する。

【０００２】

【従来の技術】以下に従来のアーク溶接法を図面を参照して説明する。図５は従来のアーク溶接法による装置の概略構成図である。図において、１は電極、２はアーク、３は被溶接物、４は交流電源であり、電極１と被溶

接物３との間に交流電源４を供給し不活性ガス（図示せず）中で溶接を行うものである。T_{EN}電極１が（−）マイナス、被溶接物３が（＋）プラスの期間で、（表１）に示すように、溶け込みが深く電極消耗が少ない。またアーク音が小さい、などの特徴を持つ。T_{EP}は電極が（＋）プラス、被溶接物が（−）マイナスの期間で、アルミニウムなど酸化物の融点が基材のアルミニウムの融点より高く、溶接の阻害となる場合に、酸化物除去作用を持つ。

【０００３】

【表１】

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	酸化膜除去作用	溶け込み	電極消耗	アーク音
T_{EN}	無	深 	少 	小
T_{EP}	有	浅	大 	大

【０００４】このようにアルミニウムなど、酸化物の融点が基材（アルミニウム）の融点より高い場合は、交流の溶接電流により、T_{EN}とT_{EP}を繰り返しながら溶接を行う。一般に交流溶接電流の周波数は１００［Hz］前後で、T_{EP}の方がT_{EN}よりやや大きめで使われることが多い。

【０００５】

【発明が解決しようとする課題】しかしながら、従来のアーク溶接法のように交流の溶接電流を用いた場合、アークの指向性が悪いため、隅肉溶接や裏波溶接が難しく、また極性反転時の高周波によりアーク音が高くなる。さらにT_{EN}時の電極加熱効果により電極消耗が速い等の問題点を有していた。本発明は上記従来の問題点を解決するもので、アークの指向性に優れ、電極の消耗を少なく、アーク音が静かなアーク溶接法の提供を目的とする。

【０００６】

【課題を解決するための手段】上記目的を達成するために本発明のアーク溶接法は、交流電流期間と直流電流期間を周期的に繰り返す溶接電流を用い、その周波数を０．５～１０［Hz］とし、かつ交流電流期間の比率を３０～８０［％］と設定する。

【０００７】

【作用】上記アーク溶接法によれば交流電流に直流電流（電極（－））がプラスされ、従って熱陰極で極点が安定するためアークの指向性が増すとともに、電極の冷却作用が生じる。さらには電流の極性反転が少ないため、アーク音が静かである。

【０００８】またビード幅が広く溶け込みが浅い交流電流と反対にビード幅が狭く溶け込みが深い直流電流との繰り返しにより美しい波目形状のビードが形成される。

【０００９】

【実施例】以下本発明の一実施例について図面を参照しながら説明する。

【００１０】図１に本実施例のアーク溶接法による装置の概略構成図である。従来のアーク溶接法による装置と異なるのは、電源４から供給する電流波形である。T_{AC}が交流電流が流れている期間、T_{DC}は直流電流が流れている期間である。交流電流期間比率

【００１１】

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【数１】

$$T_{AC}/(T_{AC}+T_{DC})\times 100$$

【００１２】と交流電流と直流電流の繰り返し周波数

【００１３】

【数２】

$$1/(T_{AC}+T_{DC})$$

【００１４】を変化させながらＢ．Ｗ（ビード幅）、Ｃ．Ｗ（クリーニング幅）、Ｂ．Ｄ（ビード深さ）、Ｅ．Ａ（電極消耗）の関係を調べた。Ｃ．Ｗとは酸化膜が除去された幅のことである。それらの関係を調べた結果を図２に示す。厚さ６［mm］のアルミニウムに２００［Ａ］の電流を流し、３０［cm／分］の速度で溶接し交流電流と直流電流の繰り返し周波数（数２）は１００［Hz］に設定した。

【００１５】交流電流期間比率が増すにつれ酸化膜が除去された幅，ビード幅、共に広がり、逆にビード深さは浅くなる。一方電極消耗は増大する。交流電流期間比率の下限はクリーニング幅がビード幅より広くなる３０［％］とし、上限は電極消耗の増加が少なく、かつビード深さがあまり浅くならない８０［％］とした。

【００１６】図３に交流と直流電流の繰り返し周波数（数２）とビード深さとの関係を示す。実験条件は図４同様に厚さ６［mm］のアルミニウムに２００［Ａ］の電流を流し、３０［cm／分］の速度で溶接し、交流電流期間比率（数１）＝５０［％］に設定した。

【００１７】繰り返し周波数（数２）が１０［Hz］以下の場合波目状のビード外観を呈する。図４に本発明のアーク溶接法によるビード外観を示す。その場合波目と波目間距離を

【００１８】

【外１】

ℓ

【００１９】とし、溶接速度をｖとすると下式が成立する。

【００２０】

【数３】

$$\ell = v\times(T_{AC}+T_{DC})$$

【００２１】従って、繰り返し周波数を速くすると波目のピッチは狭くなる。通常ｖ＝３０［cm／分］であるから、繰り返し周波数（数２）に関して

【００２２】

【数４】

$$1/(T_{AC}+T_{DC})>10\ [Hz]$$

【００２３】とすると

【００２４】

【外２】

ℓ

【００２５】＝０．５［mm］となり、波目ビードは得られにくくなる。

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【００２６】

【発明の効果】以上のように本発明のアーク溶接法は交流電流期間と直流電流期間を周期的に繰り返す溶接電流を用い、その周波数を０．５～１０［Hz］とし、かつ交流電流期間比率を３０～８０％に設定して行うもので、アークの指向性が増し隅肉溶接，裏波溶接に適し、かつ電極消耗が少なく、アーク音が静かで、しかも波目状の美しいビードが得られるため、ＦＡ化に適するものとなる。

【図面の簡単な説明】

【図１】本発明のアーク溶接法による装置の概略構成図

【図２】交流電流期間比率と各性能因子との関係を示す＊図

【図３】繰り返し周波数とビード深さとの関係を示す図

【図４】本発明のアーク溶接法によるビード外観模式図

【図５】従来のアーク溶接法による装置の概略構成図

【符号の説明】

1　電極

2　アーク

3　被溶接物

4　電源

10　T_{AC}　交流電流期間

T_{DC}　直流電流期間

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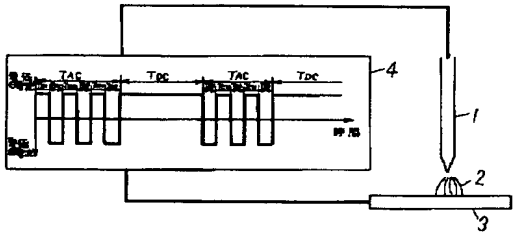
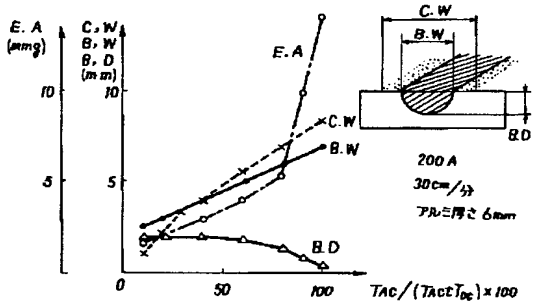
【図１】

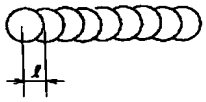


【図２】

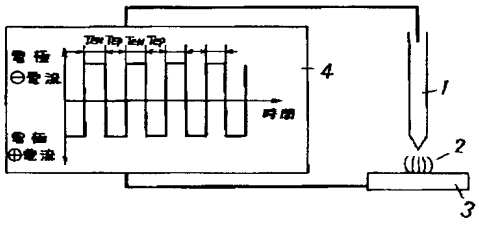


【図３】

【図４】



【図５】



JAPANESE PATENT PUBLICATION

Patent No. 2543269
Registration Date: July 25, 1996
Publication Date: October 16, 1996
Patent Application No. HEI 3-128995
Date of Filing: May 31, 1991
Application Publication No. HEI4-358364
Application Publication Date: December 10, 1992
Applicant: Matsushita Denki Sangyo Co., Ltd.
Inventors: Seigo Hagiwara et al.
Title of the Invention: Arc Welding Method

CLAIMS

(57) [Claim(s)]

[Claim 1] The arc welding method characterized by having set the frequency to 0.5-10 [Hz], and setting the ratio of the aforementioned alternating current period to 30-80 [%] using the welding current which repeats an alternating current period and a direct-current period periodically on the current supplied from a power supply.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the highly efficient arc welding method suitable for FA.
[0002]
[Description of the Prior Art] The conventional arc welding method is explained with reference to a drawing below. Drawing 5 is the outline block diagram of the equipment by the conventional arc welding method. In drawing, an electrode and 2 are AC power supply, as for a weldment-ed and 4, an arc and 3 supply AC power supply 4 between an electrode 1 and the weldment 3-ed, and 1 welds in inert gas (not shown). As (-) minus and the weldment 3-ed show [the TEN electrode 1] in (Table 1) in the period of (+) plus, penetration is deep and there are few electrode wears. Moreover, arc sound has the features, such as being small. Electrodes are [(+) plus and a weldment-ed] the periods of (-) minus, the melting point of TEP of oxides, such as aluminum, is higher than the melting point of the aluminum of a base material, and when becoming prevention of welding, it has an oxide removal operation.
[0003]
[Table 1]

	酸化膜除去作用	溶け込み	電極消耗	アーク音
T_{EN}	無	深 	少 	小
T_{EP}	有	浅	大 	大

[0004] Thus, aluminum etc. welds by the welding current of an alternating current, repeating TEN and TEP, when the melting point of an oxide is higher than the melting point of a base material (aluminum). Generally as for the frequency of alternate-polarity-operation current, the TEP is used a little in many cases by slight size from TEN before and behind 100 [Hz].
[0005]
[Problem(s) to be Solved by the Invention] However, when the welding current of an alternating current is used like the conventional arc welding method, since the directivity of an arc is bad, fillet weld and Uranami welding are difficult, and arc sound becomes high by the RF at the time of inversion. Furthermore, the electrode wear had troubles, such as being quick, according to the electrode heating effect at the time of TEN. this invention solves the above-mentioned conventional trouble, is excellent in the directivity of an arc, there are and they aim exhaustion of an electrode at offer of an arc welding method with quiet arc sound. [few]
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, using the welding current which repeats an alternating current period and a direct-current period periodically, the arc welding method of this invention sets the frequency to 0.5-10 [Hz], and sets up the ratio of an alternating current period with 30-80 [%].
[0007]
[Function] Since according to the describing [above] arc welding method a direct current (electrode (-)) is added to alternating current, therefore the pole is stabilized in hot cathode, while the directivity of an arc increases, a cooling operation of an electrode arises. Since there is still less inversion of current, arc sound is quiet.
[0008] Moreover, the bead of a beautiful ripple configuration is formed alternating current and the contrary with shallow penetration with wide bead width of face of a repeat with a direct

current with deep penetration with narrow bead width of face.
[0009]
[Example] It explains referring to a drawing about one example of this invention below.
[0010] It is the outline block diagram of equipment according to the arc welding method of this example to drawing 1 . The current wave form supplied from a power supply 4 differs from the equipment by the conventional arc welding method. TAC of the period when alternating current is flowing, and TDC is the period when the direct current is flowing. Alternating current period ratio [0011]
[Equation 1]
$T_{AC} / (T_{AC} + T_{DC}) \times 100$

[0012] Repeat frequency of alternating current and a direct current [0013]
[Equation 2]
$1 / (T_{AC} + T_{DC})$

[0014] The relation of B.W (bead width of face), C.W (cleaning width of face), B.D (bead depth), and E.A (electrode wear) was investigated making it ******. C. W is the width of face from which the oxide film was removed. The result which investigated those relations is shown in drawing 2 . The current of 200 [A] was passed to the aluminum of thickness 6 [mm], it welded at the rate of 30 [a part for cm/], and the repeat frequency (several 2) of alternating current and a direct current was set as 100 [Hz].
[0015] the width of face from which the oxide film was removed as the alternating current period ratio increased, and bead width of face -- both spreading, the bead depth becomes shallow conversely On the other hand, an electrode wear increases. The minimum of an alternating current period ratio set to 30 [%] to which cleaning width of face becomes larger than bead width of face, and the increase in an electrode wear set the upper limit to 80 [%] as for which the bead depth does not become not much shallow few.
[0016] The relation between the repeat frequency (several 2) of an alternating current and a direct current and the bead depth is shown in drawing 3 . Experiment conditions passed the current of 200 [A] to the aluminum of thickness 6 [mm] like drawing 4 , welded it at the rate of 30 [a part for cm/], and were set as alternating current period ratio (several 1) =50[%].
[0017] When repeat frequency (several 2) is below 10 [Hz], ripple-like bead appearance is presented. The bead appearance by the arc welding method of this invention is shown in drawing 4 . In this case, they are a ripple and the distance between ripples [0018]
[External Character 1]
ℓ

[0019] A lower formula will be materialized, if it carries out and the speed of travel is set to v.
[0020]
[Equation 3]
$\ell = v \times (T_{AC} + T_{DC})$

[0021] Therefore, the pitch of a ripple will become narrow if repeat frequency is made quick. Usually, since it is v= 30 [a part for cm/], it is related with repeat frequency (several 2), and it is [0022].
[Equation 4]
$1 / (T_{AC} + T_{DC}) > 10$ [Hz]

[0023] It is [0024] when it carries out.
[External Character 2]
ℓ

[0025] = It is set to 0.5 [mm] and a ripple bead becomes that it is hard to be obtained.
[0026]
[Effect of the Invention] As mentioned above, using the welding current which repeats an alternating current period and a direct-current period periodically, the arc welding method of this

invention sets the frequency to 0.5-10 [Hz], and an alternating current period ratio is set up to 30 - 80%, it performs it, its directivity of an arc increases, and it is suitable for fillet weld and Uranami welding, and there are few electrode wears and arc sound is quiet, and since a beautiful ripple-like bead is moreover obtained, it is suitable for FA-ization.

OPERATION

[Function] Since according to the describing [above] arc welding method a direct current (electrode (−)) is added to alternating current, therefore the pole is stabilized in hot cathode, while the directivity of an arc increases, a cooling operation of an electrode arises. Since there is still less inversion of current, arc sound is quiet.
[0008] Moreover, the bead of a beautiful ripple configuration is formed alternating current and the contrary with shallow penetration with wide bead width of face of a repeat with a direct current with deep penetration with narrow bead width of face.

EXAMPLE

[Example] It explains referring to a drawing about one example of this invention below.
[0010] It is the outline block diagram of equipment according to the arc welding method of this example to drawing 1 . The current wave form supplied from a power supply 4 differs from the equipment by the conventional arc welding method. TAC of the period when alternating current is flowing, and TDC is the period when the direct current is flowing. Alternating current period ratio [0011]
[Equation 1]
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[0014] The relation of B.W (bead width of face), C.W (cleaning width of face), B.D (bead depth), and E.A (electrode wear) was investigated making it ******. C. W is the width of face from which the oxide film was removed. The result which investigated those relations is shown in drawing 2 . The current of 200 [A] was passed to the aluminum of thickness 6 [mm], it welded at the rate of 30 [a part for cm/], and the repeat frequency (several 2) of alternating current and a direct current was set as 100 [Hz].
[0015] the width of face from which the oxide film was removed as the alternating current period ratio increased, and bead width of face -- both spreading, the bead depth becomes shallow conversely On the other hand, an electrode wear increases. The minimum of an alternating current period ratio set to 30 [%] to which cleaning width of face becomes larger than bead width of face, and the increase in an electrode wear set the upper limit to 80 [%] as for which the bead depth does not become not much shallow few.
[0016] The relation between the repeat frequency (several 2) of an alternating current and a direct current and the bead depth is shown in drawing 3 . Experiment conditions passed the current of 200 [A] to the aluminum of thickness 6 [mm] like drawing 4 , welded it at the rate of 30 [a part for cm/], and were set as alternating current period ratio (several 1) =50[%].
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[External Character 1]
ℓ

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[0020]
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$\ell = v \times (T_{AC} + T_{DC})$

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[Equation 4]
$1 / (T_{AC} + T_{DC}) > 10$ [Hz]

[0023] It is [0024] when it carries out.
[External Character 2]
ℓ

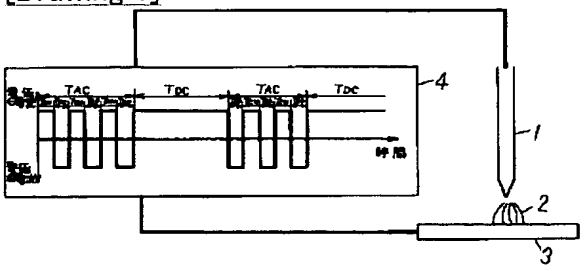
[0025] = It is set to 0.5 [mm] and a ripple bead becomes that it is hard to be obtained.

DESCRIPTION OF DRAWINGS

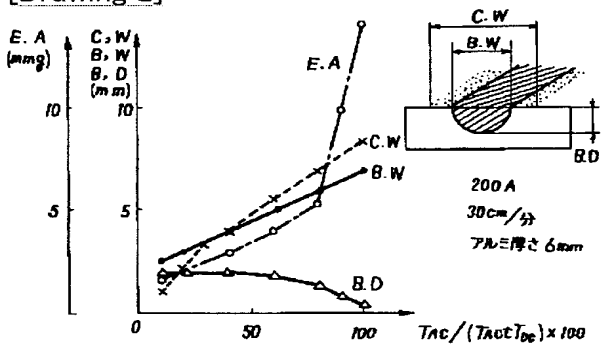
[Brief Description of the Drawings]
[Drawing 1] The outline block diagram of the equipment by the arc welding method of this invention
[Drawing 2] Drawing showing the relation between an alternating current period ratio and each performance factor
[Drawing 3] Drawing showing the relation between repeat frequency and the bead depth
[Drawing 4] The bead ****** type view by the arc welding method of this invention
[Drawing 5] The outline block diagram of the equipment by the conventional arc welding method
[Description of Notations]
1 Electrode
2 Arc
3 Weldment-ed
4 Power Supply
TAC Alternating current period
TDC Direct-current period

DRAWINGS

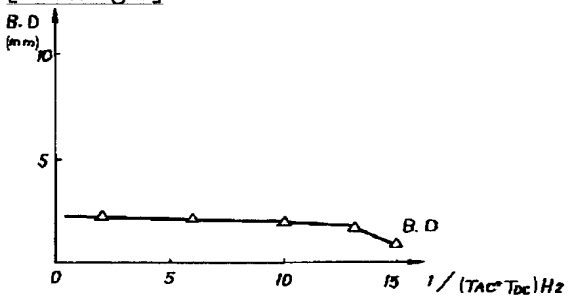
[Drawing 1]



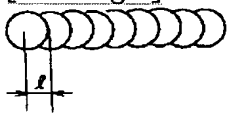
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Drawing 5]